Alternative Connection Methods

Peer-to-Peer
routing via other NodeB's

CDMA Radio Link

Direct Connection

Node B

Node B

11'

11'

Network
Controller

RNC

SGSN

LAC

14

15

16

10

23

22

21

25

Router

24

26

Microwave Radio
or Landline Link

Internet /
Intranets

27

Microcell
Basetation
"Node B"

11

13

12

18

CDMA
Radio
Link

Susbcriber
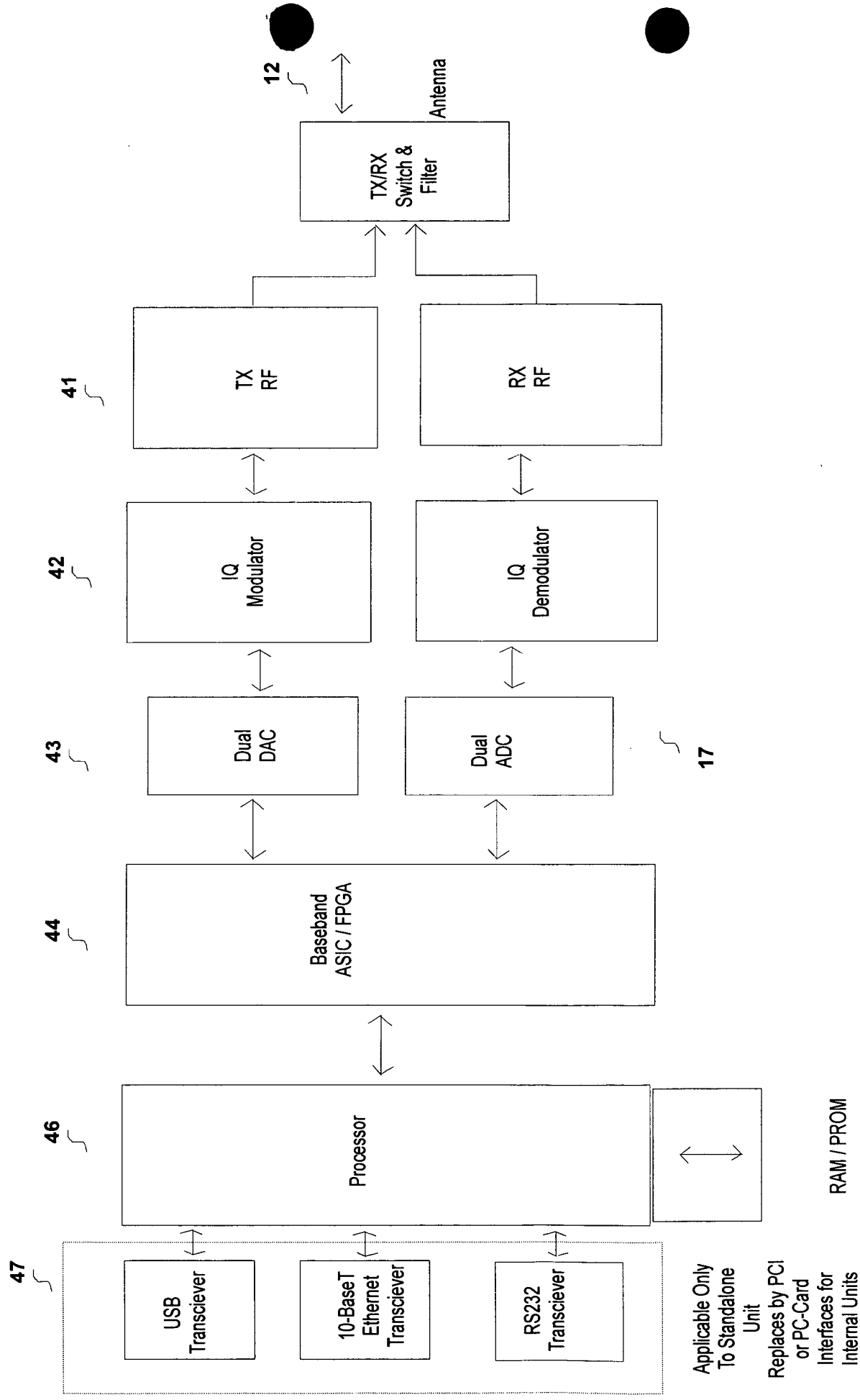Terminal / User
Equipment
"UE"

17

Computer
Interface

Figure 1
System Architecture

Figure 2
Basestation (NodeB)

12

Antenna

| TX/RX Switch & Filter |

41

| TX RF |
| RX RF |

42

| IQ Modulator |
| IQ Demodulator |

43

| Dual DAC |
| Dual ADC |

17

44

| Baseband ASIC / FPGA |

46

| Processor |

RAM / PROM

47

| USB Transciever |
| 10-BaseT Ethernet Transciever |
| RS232 Transciever |

Applicable Only
To Standalone
Unit
Replaces by PCI
or PC-Card
Interfaces for
Internal Units

Figure 3
User Equipment (UE)
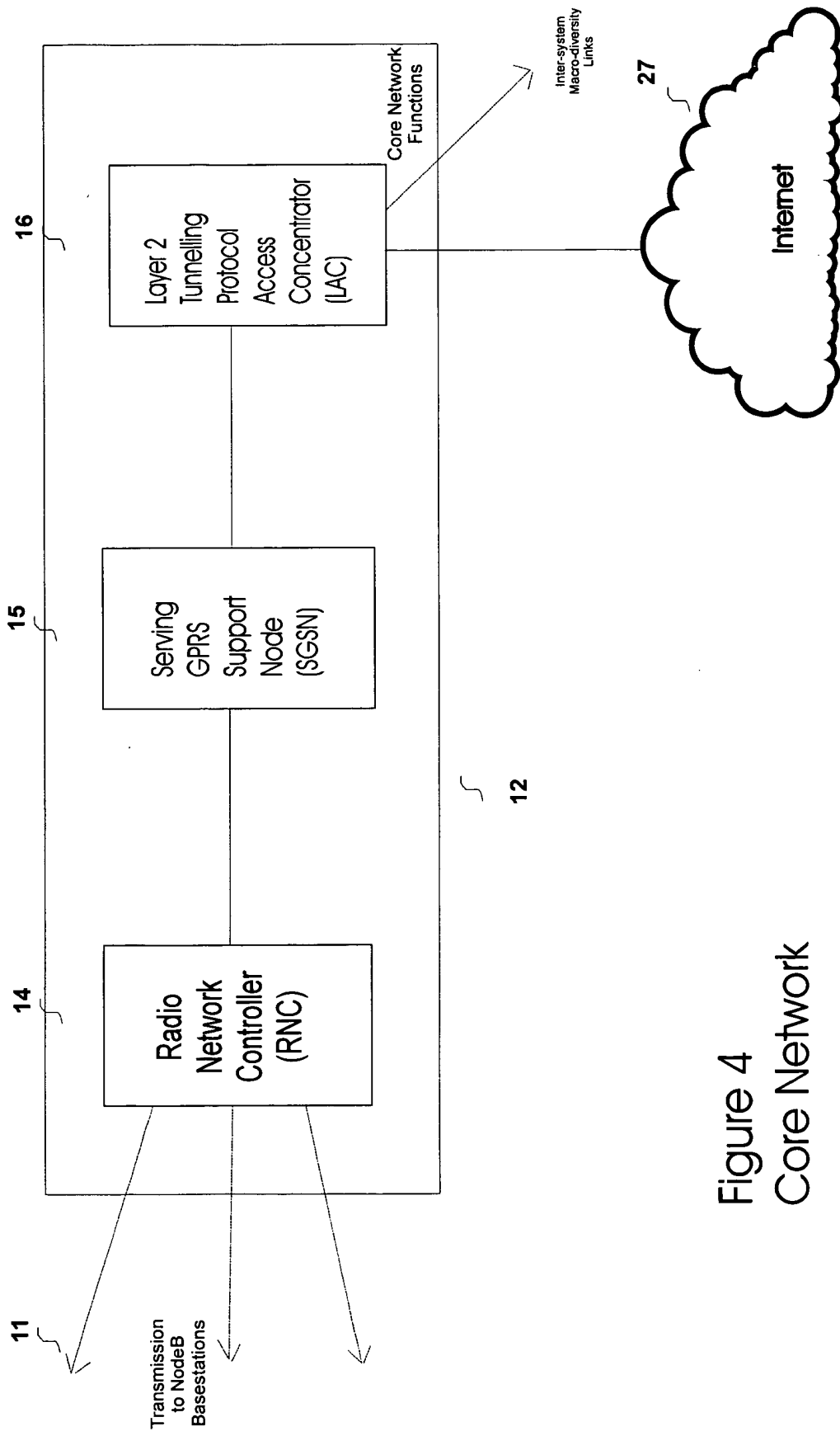
Transmission
to NodeB
Basestations

11

14

Radio
Network
Controller
(RNC)

15

Serving
GPRS
Support
Node
(SGSN)

16

Layer 2
Tunnelling
Protocol
Access
Concentrator
(LAC)

Core Network
Functions

Inter-system
Macro-diversity
Links

27

12

Internet

Figure 4
Core Network

35 Mile
Protection
Radius

53

Transmit
Site

52

Adjoining Service Area
(other operator)

"Reference Level" -
Signal Level at Boundary
Which Establishes
Reference Level for
Interference
Determination
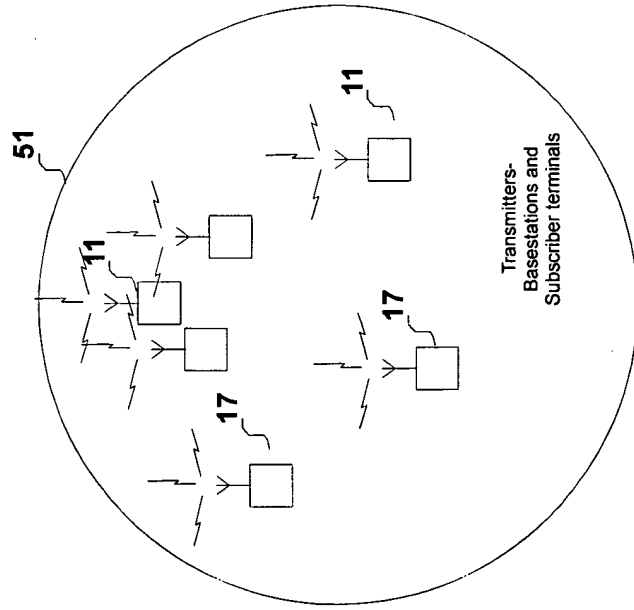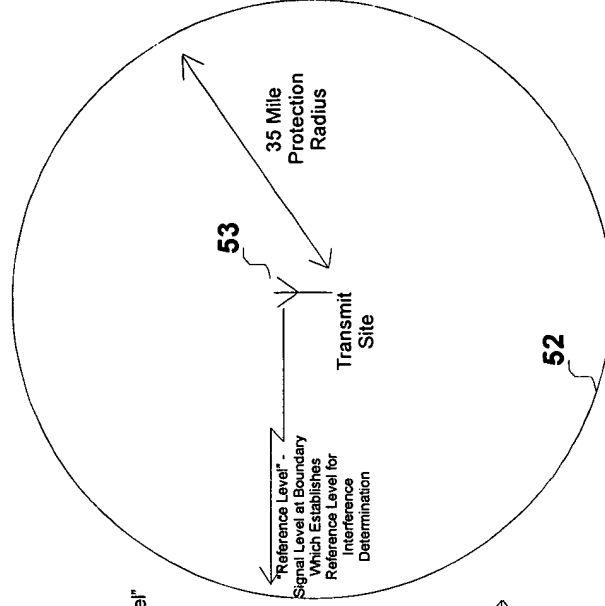
54 Aggregate Signal Level No Greater
Than -45 dB relative to "Reference Level"
on co-channel (same channel as in
adjoining service area)

55 Aggregate Signal Level No Greater
Than 0 dB relative to the wanted signal
on an adjacent channel either in the same
service area or in adjacent service area
(channel adjacent in frequency to that used
by another licensee)

56 Absolute Aggregate Signal Level No Greater
Than -73 dBW/m²

51

11

11

17

17

Transmitters-
Basestations and
Subscriber terminals

Service Area

Figure 5
FCC Interference Rules

35 Mile
Protection
Radius

53

Transmit
Site

52

Adjoining Service Area
(other operator)

50

Dynamic power control (as per prior art)
sets transmit power level to the minimum
level required to maintain viable communication
and thereby reduces aggregate interference
generated by multiple transmitters

Aggregate Signal
Level reduced by
Building Penetration,
Foliage Penetration,
Building Clutter and
Terrain Losses

63

Terrain
Losses

62

Building
Clutter
Losses

61

Foliage
Penetration
Losses

11

65

Building Penetration
Losses

Basestation
Mounted Within
Building and
Foliage Clutter

64

Subscriber
Terminal

Building Penetration
Losses

Low Power CDMA,
Spread Spectrum Basestations
and Subscriber Terminals

16 Mhz Channel
Bandwidth Reduces
Interference Measured
in 6 MHz Bandwidth

17

Service Area

Figure 6
Interference Avoidance
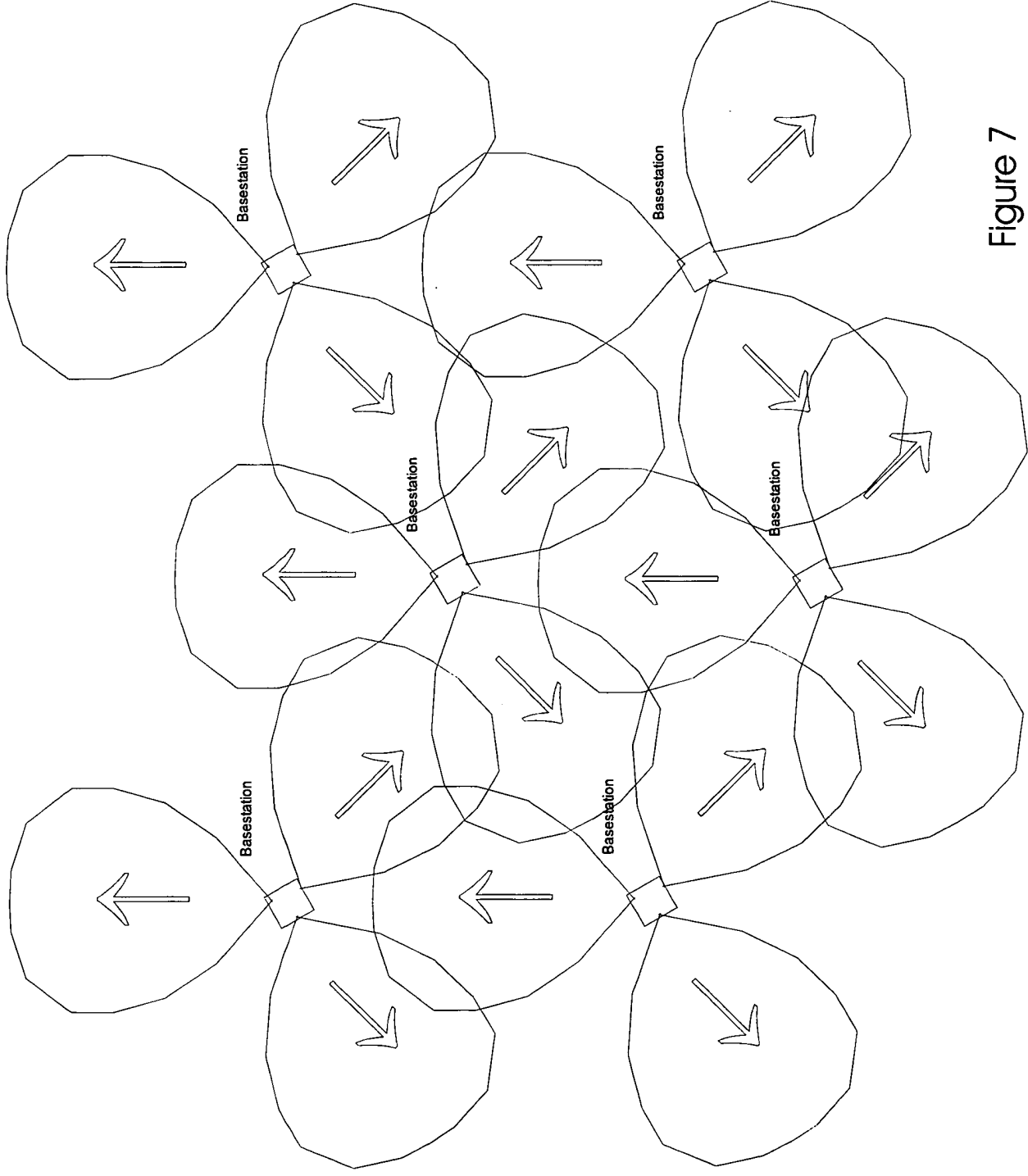
Figure 7
Prior Art:- Typical Cellular
Wireless Coverage Pattern

Basestation

Basestation

Basestation

Basestation

Basestation

Basestation

Service Area

51

51

Micro-cell

Micro-cell

Micro-cell

Micro-cell

Micro-cell

Micro-cell

Micro-cell

Micro-cell

Unidirectional Teardrop Cells

81

Directional Microcell Antennas

- limit energy transmitted towards adjacent license area

- reject interference from adjacent licence area

Adjacent License Area

52

Interference *from* adjacent license area to IPCell System

94

Interference *to* adjacent license area *from* IPCell System

96

Figure 8
Interference Reduction -
Unidirectional Teardrop
Cellular Wireless Coverage Pattern
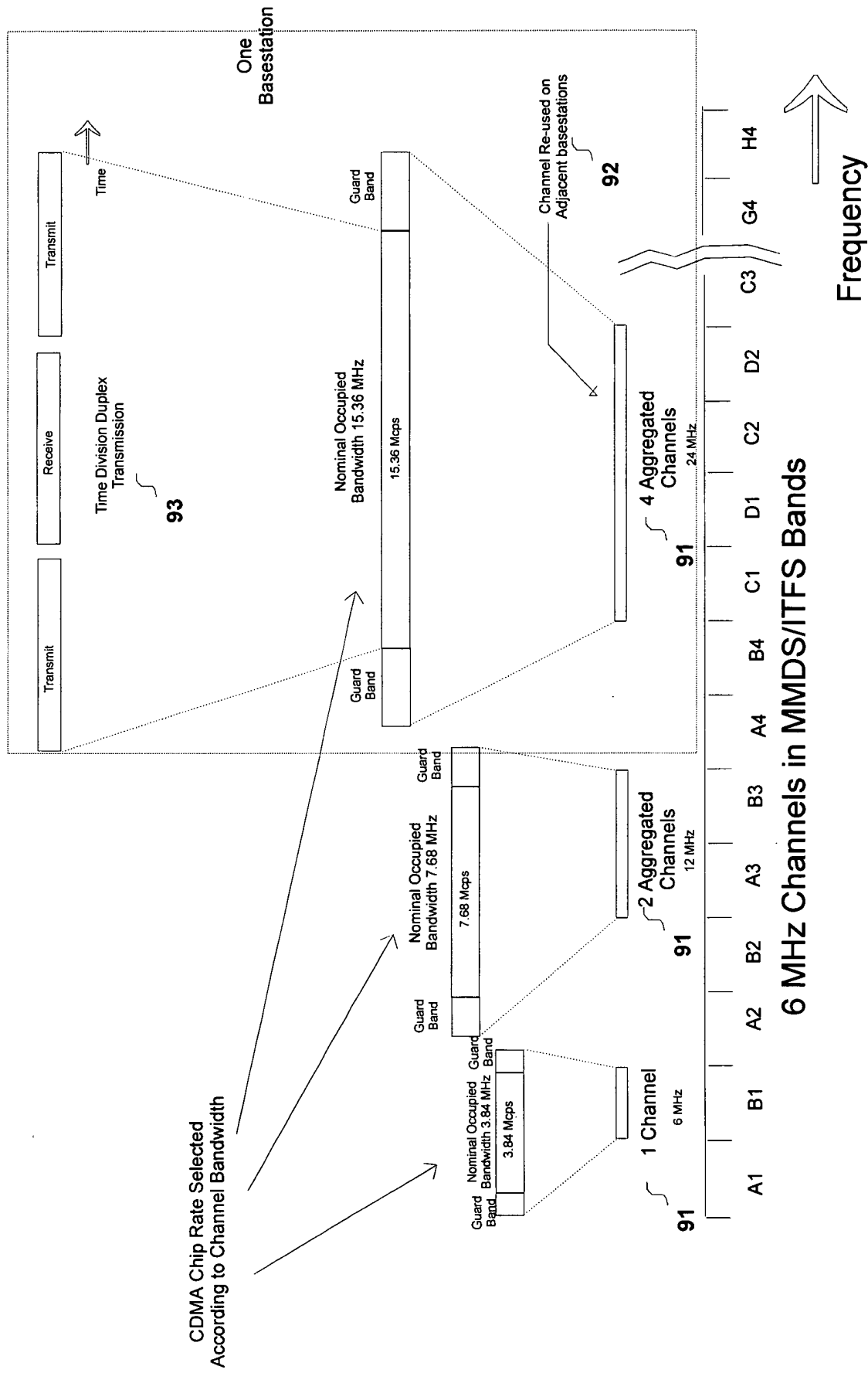
Figure 9
RF Channel Utilization

Each code used is orthogonal to other codes (these are mutually non-interfering codes when combined (summed)for example:
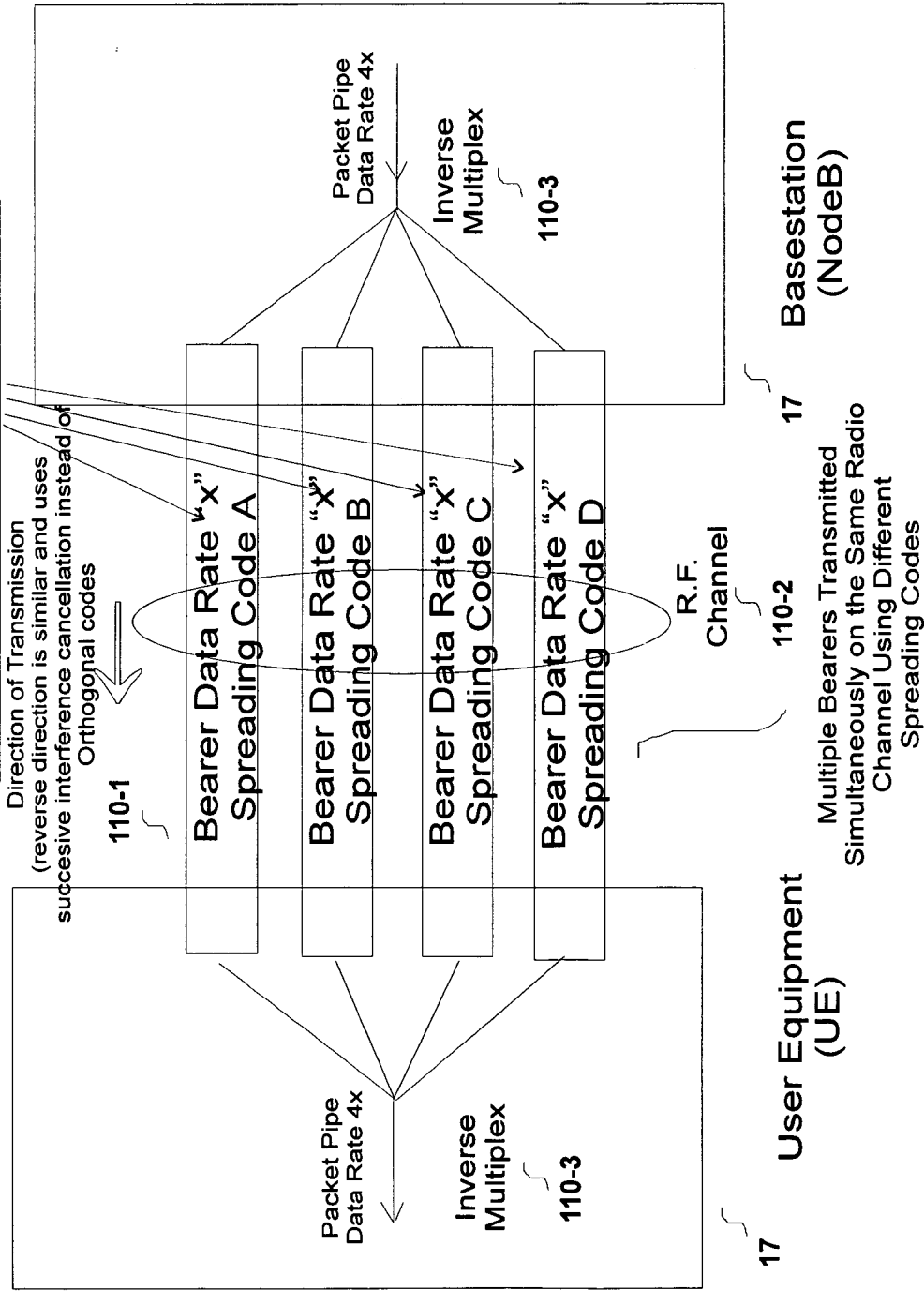
Code A +1 +1 -1 -1
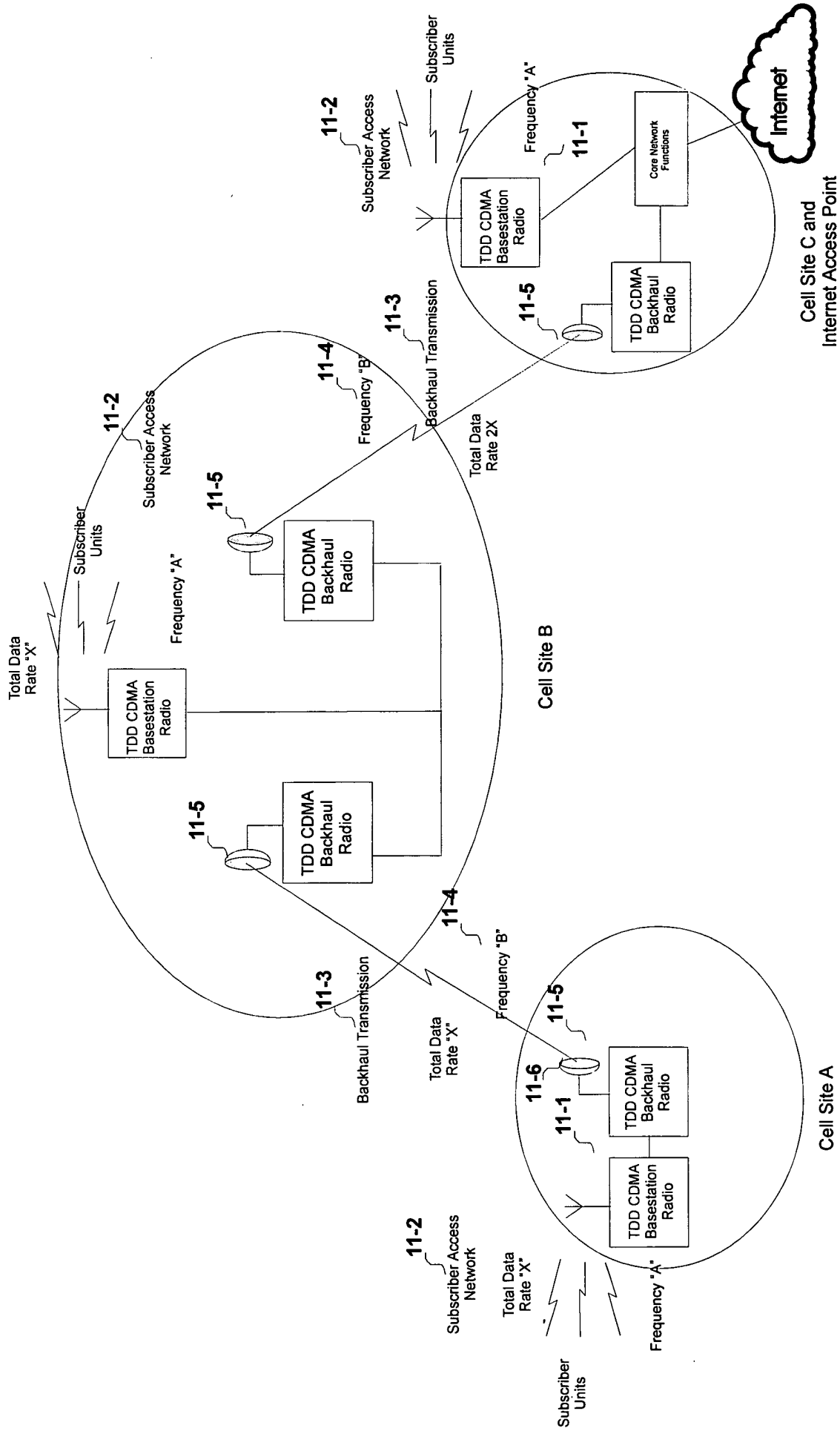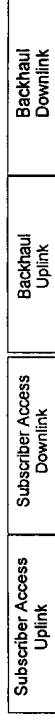Code B +1 -1 +1 -1
sum +2 0 0 -2 = 0

Packet Pipe
Data Rate 4x

Inverse
Multiplex

110-3

Basestation
(NodeB)

17

Direction of Transmission
(reverse direction is similar and uses
succesive interference cancellation instead of
Orthogonal codes

110-1

Bearer Data Rate "x"
Spreading Code A

Bearer Data Rate "x"
Spreading Code B

Bearer Data Rate "x"
Spreading Code C

Bearer Data Rate "x"
Spreading Code D

R.F.
Channel

110-2

Multiple Bearers Transmitted
Simultaneously on the Same Radio
Channel Using Different
Spreading Codes

Packet Pipe
Data Rate 4x

Inverse
Multiplex

110-3

User Equipment
(UE)

17

Figure 10
Multiple Bearer Transmission

Figure 11
CDMA Backhaul Transmission

12-1

Radio Frames

Subscriber Access Uplink	Subscriber Access Downlink	Backhaul Uplink	Backhaul Downlink
T 1	T 2	T 3	T 4 Time →

Spreading factor "y"
Bearer rate = X

Subscriber Units

Frequency "A"

TDD CDMA Basestation Radio

Core Network Functions

Internet

Cell Site C and Internet Access Point

Spreading factor y/2
Bearer rate = 2X

Frequency "B"

Subscriber Access Antenna

Backhaul Antenna

Subscriber Units

Backhaul Antenna

TDD CDMA Basestation Radio

Backhaul Antenna

Cell Site B

Spreading factor "y"
Bearer rate = X

Frequency "A"

Spreading factor y/2
Bearer rate = 2X

Frequency "B"

84

Backhaul Antenna

82

Subscriber Access Antenna **83**

TDD CDMA Basestation Radio

Cell Site A

Spreading factor "y"
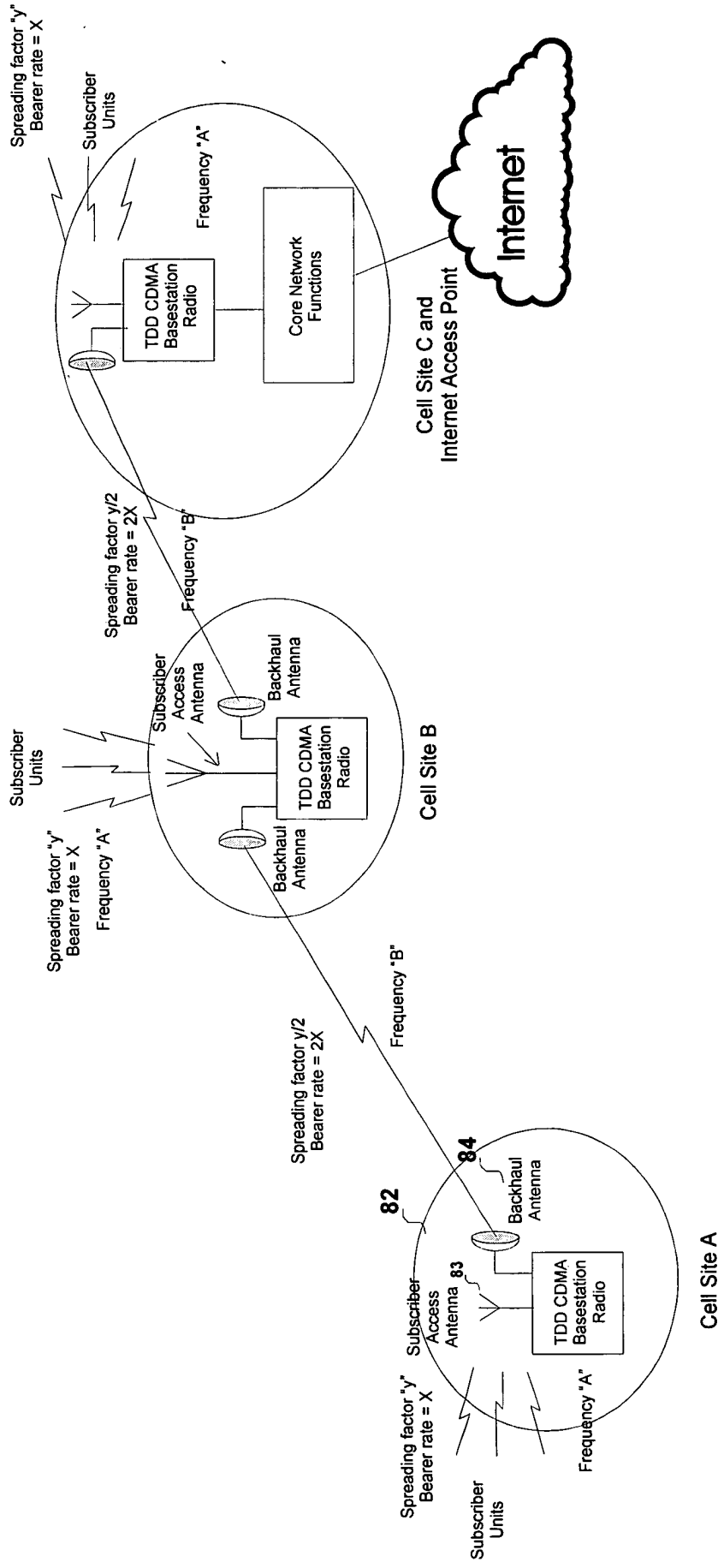Bearer rate = X

Subscriber Units

Frequency "A"

Figure 12
Peer to Peer Backhaul Routing
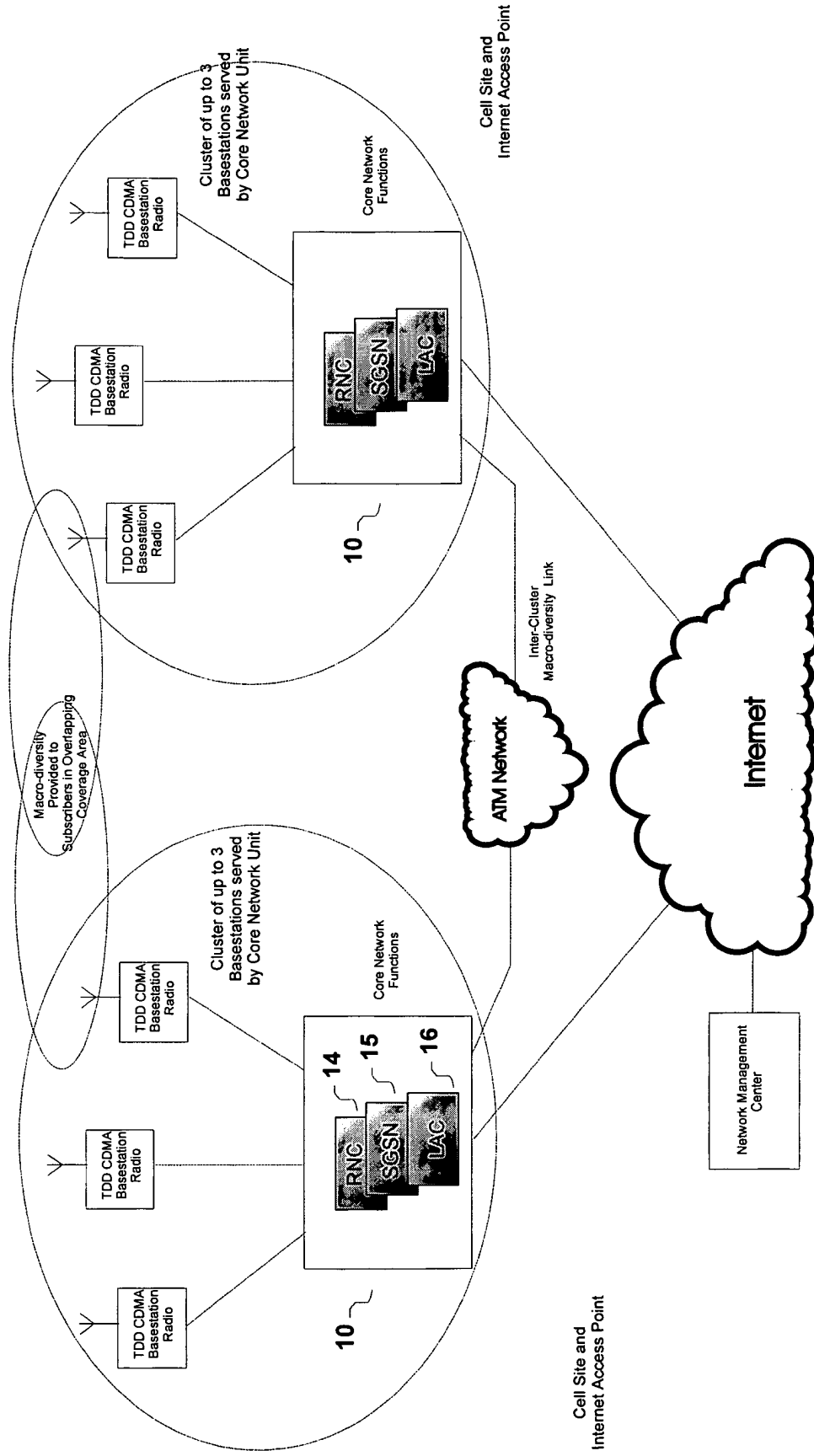
Figure 13
Distributed Core Network Functions
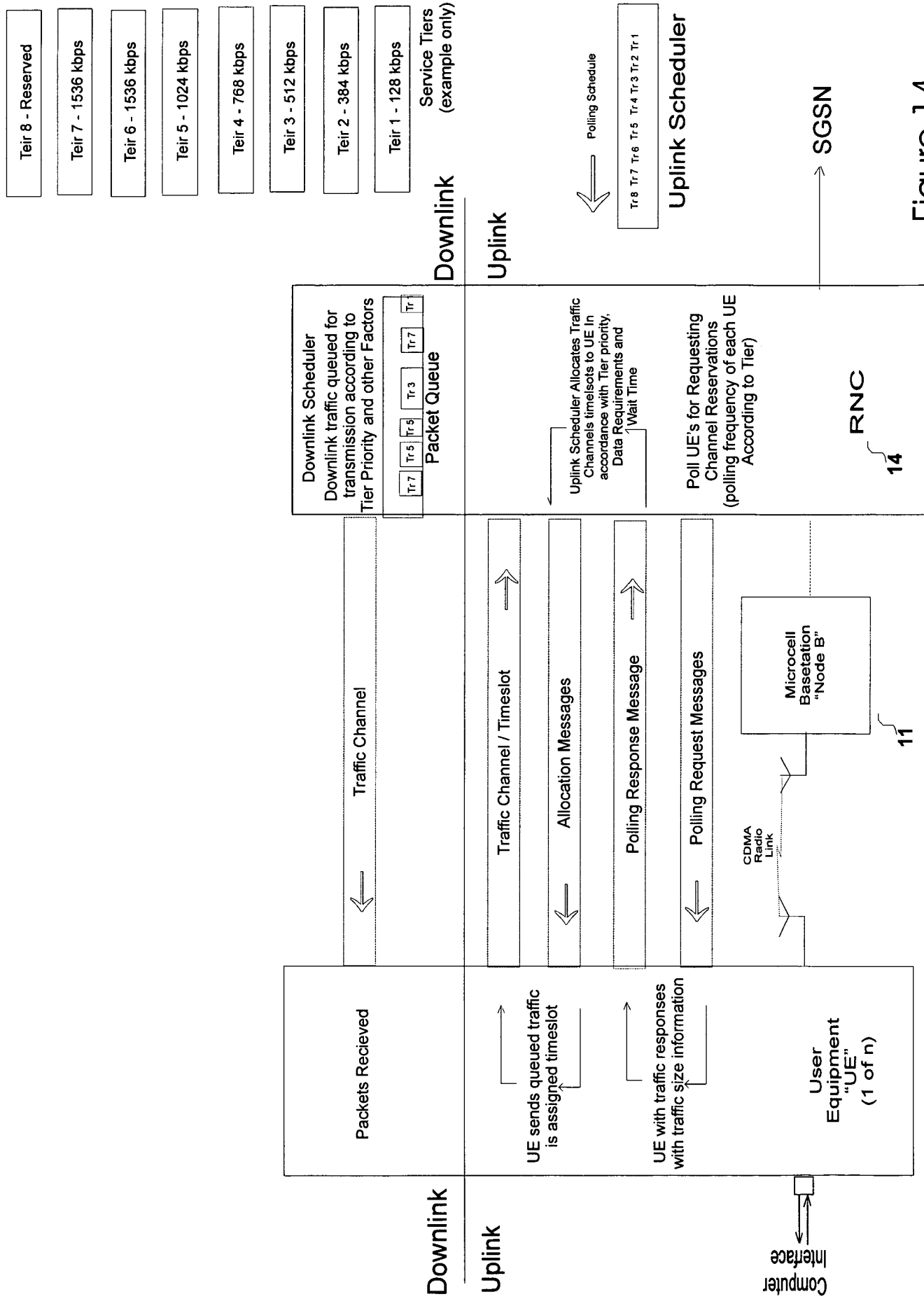
Figure 14
Service Tiering

Figure 15
Enhanced Time-Division-Duplex

Radio Network Controller (RNC)

If delay less than Symbol Period, set Spreading factor (SF) = 8, otherwise SF =16

If SF=8, and S/I less than preset threshold, set SF16, otherwise maintain SF=16

14

Basestation (NodeB)

Data received in time slot on radio frame

Basestation measures excess delay on received signal

Basestation measures signal to interference (S/I) ratio on received signal

SF in Basestation set as determined by RNC for both uplink and downlink

Data Transmitted to UE in in next designated timeslot

11

Subscriber /User Equipment (UE)

SF in UE set as determined by RNC for both uplink and downlink

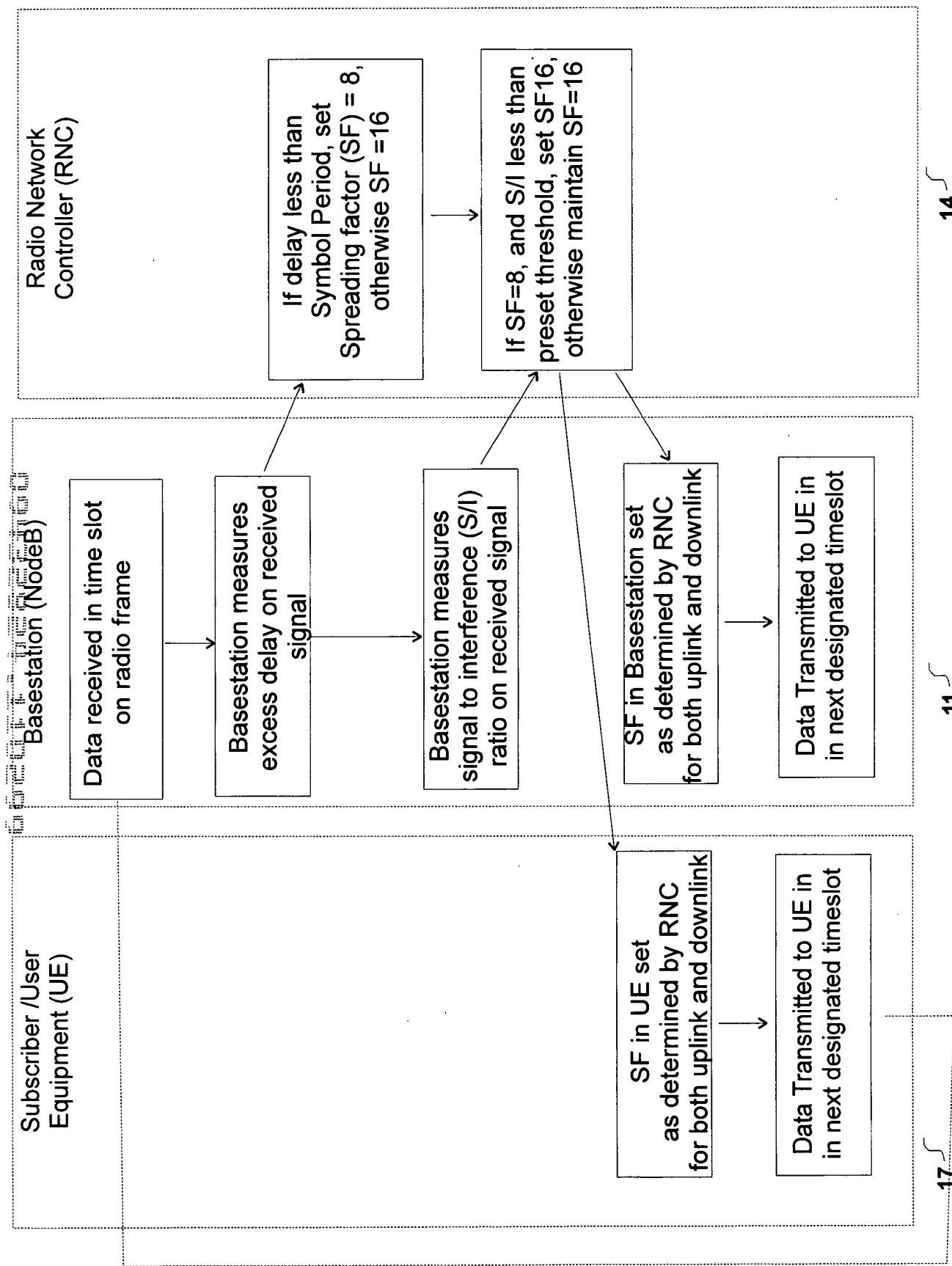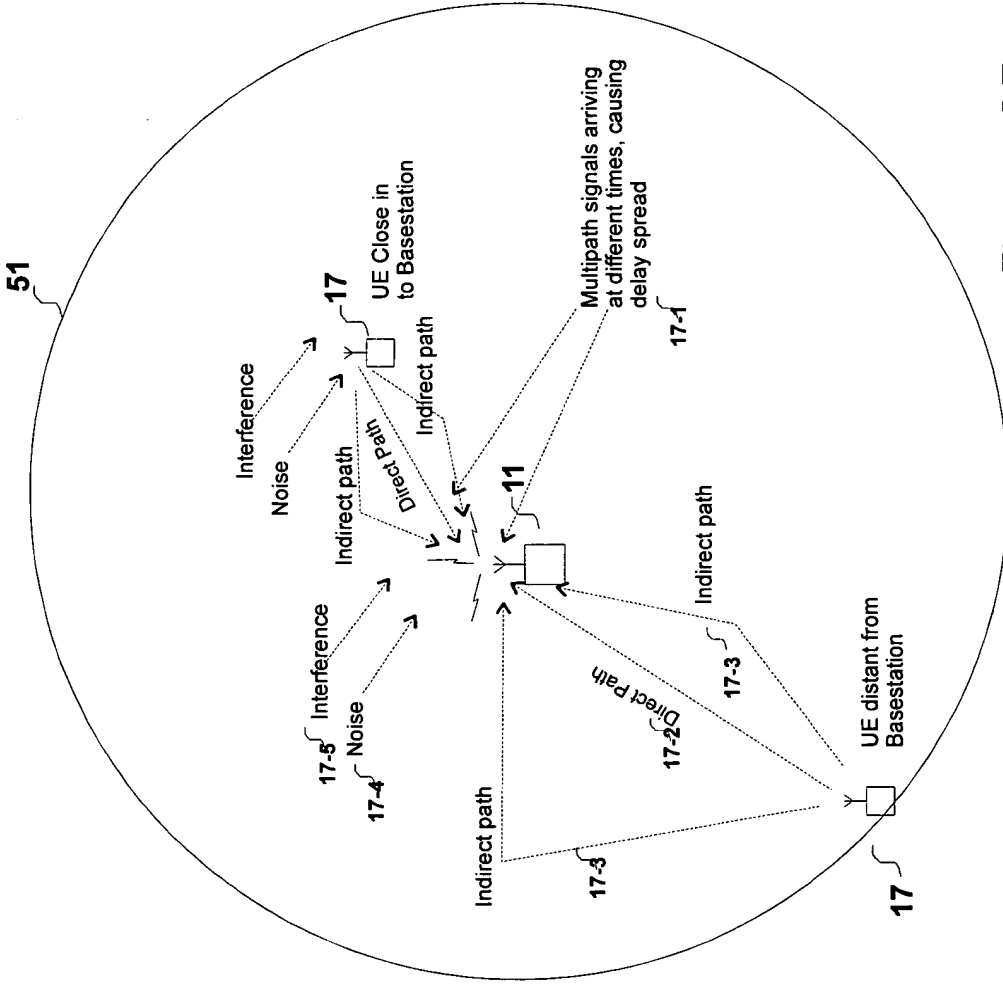Data Transmitted to UE in in next designated timeslot

17

Figure 16
Transmission Rate Adaption

Figure 17
Transmission Rate Adaption
Channel Measurement

37

Part of Base Station Receiver Baseband Processors

Figure 18 - Successive
Interference Cancellation